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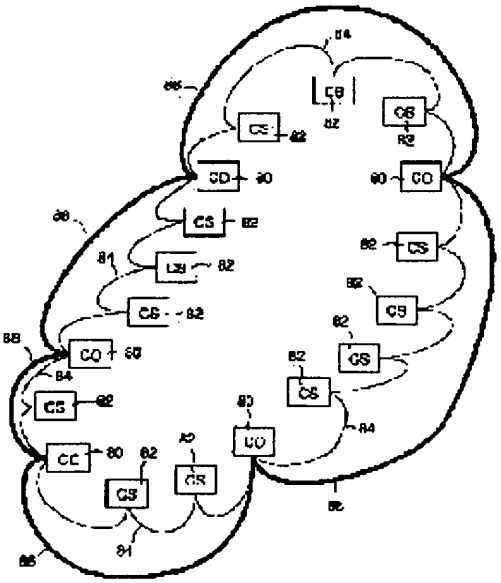
(54) OPTICAL NETWORK SYSTEM

(57)Abstract:

PROBLEM TO BE SOLVED: To improve flexibility and reliability and to reduce laying costs by constituting a landing station of a central office having much traffic and a cable station having a little traffic, and connecting them through an integrated optical repeater cable.

SOLUTION: The landing station is composed of a central office CO 80 for covering a main area with much traffic and a cable station CS 82 for covering the area with relatively little traffic. Further, all the CO 80 and CS 82 are mutually connected through an optical non-repeater cable 84, and the CO 80 are mutually connected through an optical light amplifying and repeating underwater cable 86. With such a redundant configuration, even when a fault occurs at the optical non-repeating cable 84 or the optical light amplifying and repeating submarine cable 86, that fault does not propagate to the entire network. Moreover, by defining the landing station having much traffic as the central office 80, the network can be constituted corresponding to the quantity of traffic and integrating the cable, the laying costs can be



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CLAIMS

[Claim(s)]
[Claim 1] The optical network system characterized by consisting of a non-acted as intermediary light network which connects all the terminal offices, and an owner junction light network which connects a part of terminal offices.
[Claim 2] The optical network system according to claim 1 with which the optical transmission medium of the above-mentioned non-acted as intermediary light network and the optical transmission medium of the above-mentioned owner junction light network are held in the same cable at least by those parts.
[Claim 3] The optical network system with which the terminal office which consists of a non-acted as intermediary light network by the optical transmission medium non-acted as intermediary and an owner junction light network by the owner junction optical transmission medium, and is connected to the owner junction light network concerned is characterized by connecting also with the non-acted as intermediary light network concerned.
[Claim 4] The optical network system characterized by consisting of a full network which connects all the terminal offices, and a zone network which connects two or more terminal offices of all the terminal offices concerned.
[Claim 5] The optical network system according to claim 4 with which the above-mentioned full network consists of an optical transmission medium non-acted as intermediary, and the above-mentioned zone network consists of a junction magnification optical transmission medium.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] More specifically, this invention relates to the optical network system suitable for submarine construction about an optical network system.
[0002]
[Description of the Prior Art] The conventional marine optical cable network combines an optical amplification submarine cable and a sea diverging device. Drawing 4 is the example and shows the specific area, for example, the marine optical cable network which acts as Japan 1 round. It is made the shape of a loop formation by using the fiber-optic cable 10 incorporating an optical amplification fiber as a trunk cable, and the optical diverging device 12 is connected to the suitable part of the loop formation through connection and a branch cable 14 at the cable station (landing station) 16. Generally, although a branch cable 14 consists of a fiber-optic cable incorporating an optical amplification repeater, when the distance between the optical diverging device 12 and the cable station 16 is short, it may not carry out optical amplification junction.
[0003] Drawing 5 shows the conceptual diagram of an optical amplification relay system. Intensity modulation of the output light (continuation light) of a laser light source 18 is carried out with an optical modulator 20, and it inputs into an optical transmission line 22. Generally an optical transmission line 22 consists of a configuration of having relayed distributed shift optical fiber 22a for transmission by optical amplification repeater 22b. While transmitting an optical transmission line 22, although optical reinforcement is decreased in the part of optical fiber 22a and is reinforced by optical amplification repeater 22b, generally the noise accumulates it. As for the light which transmitted the optical transmission line 22, the wave is distorted by the nonlinearity of an optical transmission line 22, wavelength dispersion, polarization distribution, etc. It lets the output light of an optical transmission line 22 pass to the optical band pass filter 24, a desired wavelength component is extracted, and it is impressed by the photodiode 26. A photodiode 26 changes a lightwave signal into an electrical signal. The output of a photodiode 26 is amplified with the electric stage amplifier 28. Data are reproduced from the output of the electric stage amplifier 28.
[0004] The example of a configuration of optical amplification repeater 22b is shown in drawing 6 . First, input light is inputted into the erbium dope fiber 30, and optical amplification is carried out here. Laser diode 32 generates the excitation light of the erbium dope fiber 30, and the excitation light is inputted into the erbium dope fiber 30 from an output side through the wavelength division multiplex light coupler 34. The lightwave signal amplified with the erbium dope fiber 30 is outputted outside through a coupler 34, an optical isolator 36, and the gain identification filter 38.
[0005] At drawing 5 , although illustrated only about one optical-fiber-transmission way, in order to make [many] transmission capacity of one cable at least in cable-izing on the basis of going up and two optical fibers getting down, i.e., an optical fiber pair, in the actual system, two or more fiber pairs (for example, two pairs) are held.
[0006] The example of connection of a trunk cable 10 and a branch cable 14 in a diverging device 12 is

shown in drawing 7 and drawing 8 . Here, the trunk cable 10 supposes that it will consist of four optical fibers, i.e., 2 fiber pairs.

[0007] In drawing 7 , a branch cable 12 possesses a twice as many optical fiber as the number of optical fibers of a trunk cable 10, it becomes some branch cables 12 as it is with the optical diverging device 12, and connects with the cable station 16, and four another optical fibers from the cable station 16 connect a trunk cable 10 to a trunk cable 10 as it is from a branch cable 14. That is, in this example of connection, it is what connected between adjoining cable stations according to the individual.

[0008] On the other hand, in drawing 8 , by using only two of four optical fibers of a trunk cable as a branch cable 14, it connects with the cable station 16 and let other two be through within a diverging device 12.

[0009] As a means to increase transmission capacity, wavelength division multiplexing attracts attention. In wavelength division multiplexing, about the specific wavelength of two or more wavelength which transmits a trunk cable, it multiplexs from a branch cable to a trunk cable (ad), and the ad / drop equipment which branches from a trunk cable to a branch cable (drop) are used.

[0010] Drawing 9 shows the outline configuration block Fig. of an example of an ad / drop equipment. The ad / drop equipment shown in drawing 9 do the ad/drop of wavelength lambda 2 among eight wavelength lambda1-lambda8. The lightwave signal (wavelength lambda1-lambda8) from the trunk cable 40 of an input side is inputted into A port of an optical circulator 42. An optical circulator 42 is a light corpuscle child who outputs the lightwave signal inputted into A port from a B port, and outputs the lightwave signal inputted into a B port from C port. The lightwave signal inputted into C port is not used here, although outputted from A port.

[0011] An optical circulator 42 inputs the lightwave signal from the trunk cable 40 of an input side into the fiber grating 44 from a B port as it is. The fiber grating 44 is designed so that lambda 2 may be reflected. Therefore, among the lightwave signals outputted from the B port of an optical circulator 42, the wavelength component except wavelength lambda 2 passes the fiber grating 44, and inputs it into the B port of an optical circulator 46, it is reflected by the fiber grating 44 and wavelength lambda 2 is again inputted into the B port of an optical circulator 42. Since an optical circulator 42 outputs the light inputted into a B port from C port, after all, among the lightwave signals from the trunk cable 40 of an input side, only the lightwave signal of wavelength lambda 2 is outputted to a branch cable 48 from C port of an optical circulator 42, and is transmitted to a branching station or a cable station (not shown). That is, wavelength lambda 2 is dropped.

[0012] The lightwave signal of the wavelength lambda 2 which is supplied from a branching station or a cable station etc. which is not illustrated and which should be carried out an ad is inputted into A port of an optical circulator 46 through a branch cable 50. The optical circulator 46 is completely the same as an optical circulator 42 as input-output behavioral characteristics. Although the lightwave signal of the wavelength lambda 2 which should be carried out an ad is outputted towards the fiber grating 44 from the B port of an optical circulator 46, it is reflected by the fiber grating 44 and it returns to the B port of an optical circulator 46. That is, the wavelength component excluding wavelength lambda 2 from the input-side trunk cable 40 and the lightwave signal of the wavelength lambda 2 of a branch cable 50 which should be carried out an ad input into the B port of an optical circulator 46, wavelength multiplexing of these is carried out and they are outputted to the output side trunk cable 52 from C port of an optical circulator 46. Thus, the ad of the lightwave signal of wavelength lambda 2 is carried out to a trunk cable 52.

[0013] In addition, as a trunk cable is shown in drawing 10 , without making it the shape of a loop formation, there is also a network made straight. The trunk cable 64 which consists of an optical amplification submarine cable between two cable stations 60 and 62 is laid, and other cable stations 66-1 to 66-7 are connected with the diverging device 70-1 to 70-7 on a trunk cable 64 through a branch cable 68-1 to 68-7.

[0014]

[Problem(s) to be Solved by the Invention] The conventional example shown in drawing 4 and the conventional example shown in drawing 10 have the fault of having serious effect on the whole

network, when a failure occurs in trunk cables 10 and 64. the case of the conventional example shown in drawing 4 -- the failure of a trunk cable 10 -- predicting -- oh, if the rudder detour design is carried out, hard flow will be made to bypass a signal at the time of failure generating -- it comes out and the communication link between the latest cable stations can be secured at least. However, traffic will become too heavy to hard flow even in this case. In the conventional example shown in drawing 10 , the communication link between the cable station 60 and 62 becomes impossible according to the failure of a trunk cable 64.

[0015] Moreover, in the conventional example, each cable station is completely treated equally and it was difficult or impossible to set up the capacity according to a communications traffic.

[0016] Then, this invention aims at showing an optical network system strong against a failure.

[0017] This invention aims at showing the optical network system which can set up channel capacity flexibly again.

[0018]

[Means for Solving the Problem] In this invention, the non-acted as intermediary light network which connects all the terminal offices, and the owner junction light network which connects a part of terminal offices are prepared. Or the full network which connects all the terminal offices, and the zone network which connects two or more terminal offices of all the terminal offices concerned are prepared.

[0019] By such configuration, redundancy-ization of a transmission line can be attained and it becomes strong with a failure. That is, even if a failure occurs to one network, the channel between the terminal offices is securable by minding the network of another side. Moreover, the terminal office which needs much transmission capacity, and the terminal office as which comparatively small transmission capacity is sufficient can be distinguished, and it becomes easy to set up the capacity according to a communications traffic.

[0020]

[Embodiment of the Invention] Hereafter, the gestalt of 1 operation of this invention is explained to a detail with reference to a drawing.

[0021] Drawing 1 shows the outline configuration block Fig. of the 1st example of this invention. this example -- **** -- traffic -- many -- main -- an area -- covering -- central - office -- (-- CO --) -- 80 -- traffic -- comparatively -- being few -- an area -- covering -- a cable - a station -- (-- CS --) -- 82 -- two -- a kind -- landing -- a station -- it is . all -- landing -- a station -- namely, -- all -- central - office -- (-- CO --) -- 80 -- all -- a cable - a station -- (-- CS --) -- 82 -- adjoining -- a station -- between ---less -- junction -- an optical cable -- 84 -- minding -- mutual -- connecting -- having -- all -- landing -- a station -- connecting -- ** -- saying -- a viewpoint -- a full network -- constituting . Moreover, central office 80 comrades constitute a zone network from a viewpoint of connecting mutually through the optical amplification junction submarine optical cable 86, and connecting some landing stations.

[0022] namely, -- this example -- **** -- landing -- a station -- being big -- channel capacity -- needing -- central - office -- (-- CO --) -- 80 -- usually -- extent -- channel capacity -- **** -- a cable - a station -- (-- CS --) -- 82 -- dividing -- a transmission line -- the marine optical cable 84 non-acted as intermediary and the optical amplification junction submarine optical cable 86 of owner junction -- redundancy --- izing . By such redundancy-ized configuration, the independent failure of either the transmission line 84 non-acted as intermediary or the owner junction transmission line 86 does not turn into a failure to the whole network. It is because it can communicate via the direction which has not generated a failure. That is, in this example, only when a failure occurs in the same zone at coincidence in both the transmission line 84 non-acted as intermediary and the owner junction transmission line 86, the communication link to some landing offices in the zone is checked.

[0023] At this example, the network according to the amount of traffic can be built by making a landing station with many amounts of traffic into the central office 80. That is, according to this example, the network according to the amount of traffic can be designed, and by the redundant configuration of the system non-acted as intermediary and an owner junction system, it is rich in flexibility and a reliable network can be offered.

[0024] In the example shown in drawing 1 , it has illustrated as if it laid separately the transmission line

non-acted as intermediary and the owner junction transmission line as a separate cable, but the cost of construction can be reduced if these are summarized on one cable. Drawing 2 shows the outline configuration block Fig. of the example. 88 is central office (CO), 90 is a cable station (CS), and the submarine cable 92 which connects central office 88 comrades is cable-ized so that predetermined number possession of the optical cable non-acted as intermediary and the optical cable (namely, optical cable which arranges the optical amplification repeater at intervals of predetermined) of owner junction may be carried out, respectively. The optical cable of owner junction is connected between the central office 88, and the optical cable non-acted as intermediary is connected between the stations which the central office 88 and the cable station 90 adjoin.

[0025] The sea diverging device 94 which branches the optical cable non-acted as intermediary between the cable stations 90 is formed in every place of a submarine cable 92, and this also connects between the sea diverging device 94 and the cable stations 90 corresponding to this to them with the branch cable 96 non-acted as intermediary.

[0026] In an optical fiber system, as stated also in advance, two or more fiber pairs are held in a fiber-optic cable on the basis of going up and two fibers (fiber pair) getting down. Therefore, although two or more fiber pairs are held also in the submarine cable 92 and the branch cable 96, the mimetic diagram of the situation of connection between the cable office 88 and the cable station 90 is shown in drawing 3 about one of them. The same sign is given to the same component as drawing 2 . As explained previously, optical fiber 92a non-acted as intermediary and optical fiber 92b of owner junction are held, and optical fiber 92a non-acted as intermediary is connected through, and much magnification repeater 92c carries out magnification junction of the optical fiber 92b of owner junction, and connects with a submarine cable 92.

[0027] The sea diverging device 94 connects optical fiber 92b of owner junction to optical fiber 92b of the owner junction of the downstream as it is. Thereby, the lightwave signal from the central office 88 is transmitted to the next central office 88, without branching to the cable station 90. The sea diverging device 94 connects optical fiber 92a non-acted as intermediary to optical fiber 96a for going down of a branch cable 96, and connects optical fiber 96b for going up of a branch cable 96 to optical fiber 92a which is not relayed [of the downstream] again. Thereby, transmission of the lightwave signal non-acted as intermediary is carried out between the adjoining central office 88 or the cable station 90.

[0028] In the example shown in drawing 2 and drawing 3 , while being able to design the network according to the amount of traffic, it is rich in flexibility and not only can offer a reliable network, but it can reduce the construction cost of a cable.

[0029] It is not rare to hold two or more optical fiber pairs in a cable in an optic fiber communication system. When this invention is applied, the system non-acted as intermediary is constituted from two or more fiber pairs, and an owner junction system also consists of two or more fiber pairs. For example, when the system non-acted as intermediary is constituted from 3 fiber pairs and an owner junction system is constituted from 3 fiber pairs, in the example shown in drawing 2 , a submarine cable 92 turns into a cable which holds 12 fibers in all. Although it is needless to say, the number of fibers held in a cable is a number seen in the cross section of a cable.

[0030]

[Effect of the Invention] While being able to design the network according to the amount of traffic according to this invention so that he can understand easily from the above explanation, it is rich in flexibility and a reliable network can be offered. Furthermore, the construction cost of a cable can be reduced by cable-izing the transmission line of an owner junction system, and the transmission line of the system non-acted as intermediary to one.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the outline configuration block Fig. of the 1st example of this invention.
[Drawing 2] It is the outline configuration block Fig. of the 2nd example of this invention.
[Drawing 3] It is the mimetic diagram showing the situation of connection of the example shown in drawing 2 .
[Drawing 4] It is the outline configuration block Fig. of an example of the conventional marine optical cable network.
[Drawing 5] It is the mimetic diagram of an optical amplification relay system.
[Drawing 6] It is the mimetic diagram showing the example of a configuration of optical amplification repeater 22b.
[Drawing 7] It is the example of connection of a trunk cable 10 and a branch cable 14 in a diverging device 12.
[Drawing 8] It is another example of connection of a trunk cable 10 and a branch cable 14 in a diverging device 12.
[Drawing 9] It is the outline configuration block Fig. of an example of an ad / drop equipment.
[Drawing 10] It is the outline configuration block Fig. of another example of the conventional marine optical cable network.
[Description of Notations]
10: Fiber-optic cable
12: An optical diverging device
14: Branch cable
16: Cable station (landing station)
18: Laser light source
20: Optical modulator
22: Optical transmission line
22a: The distributed shift optical fiber for transmission
22b: Optical amplification repeater
24: An optical band pass filter
26: Photodiode
28: Electric stage amplifier
30: Erbium dope fiber
32: Laser diode
34: Wavelength division multiplex light coupler
36: Optical isolator
38: Gain identification filter
40: The trunk cable of an input side
42: Optical circulator
44: Fiber grating

46: Optical circulator
48: Branch cable
50: Branch cable
52: Output side trunk cable
60 62: Cable station
64: Trunk cable
66-1 to 66-7: Cable station
68-1 to 68-7: Branch cable
70-1 to 70-7: Diverging device
80: Central office (CO)
82: Cable station (CS)
84: The optical cable non-acted as intermediary
86: Optical amplification junction submarine optical cable
88: Central office (CO)
90: Cable station (CS)
92: Submarine cable
92a: The optical fiber non-acted as intermediary
92b: The optical fiber of owner junction
92c: Magnification repeater
94: A sea diverging device
96: Branch cable
96a: The optical fiber for going down
96b: The optical fiber for going up

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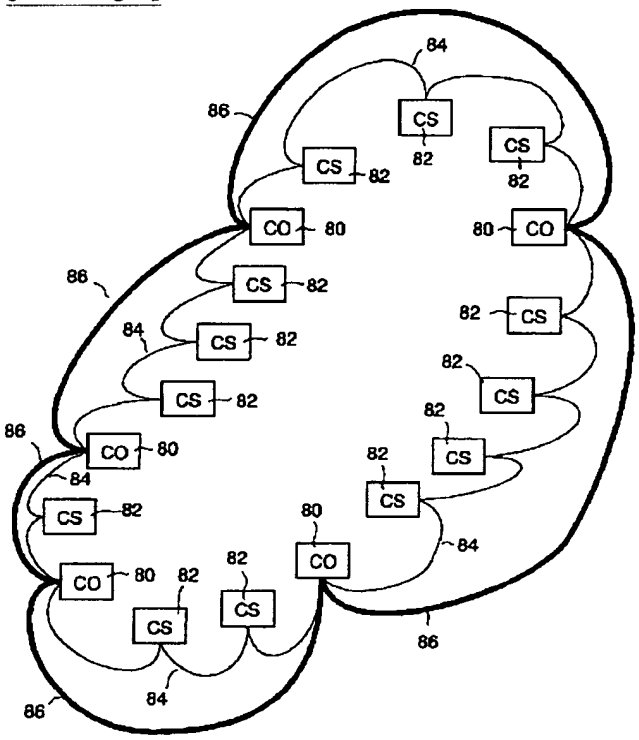
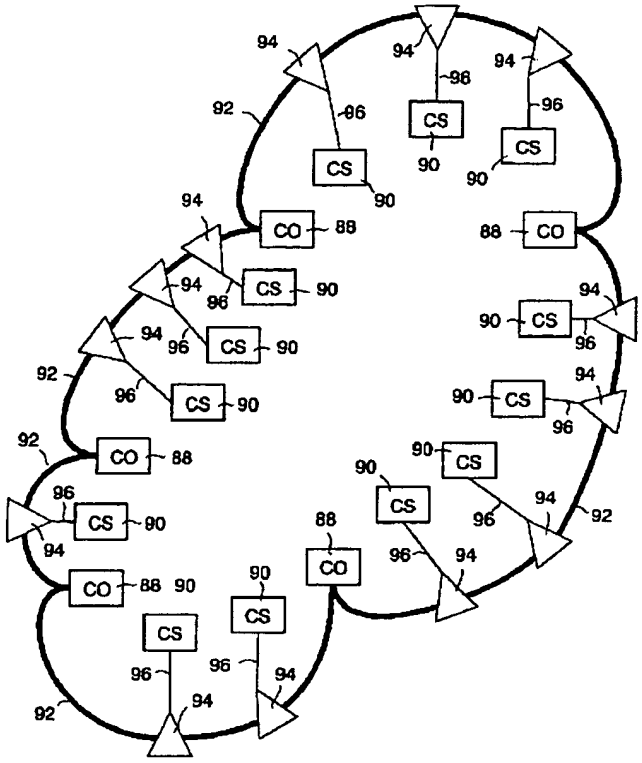
DRAWINGS

[Drawing 1]



[Drawing 2]



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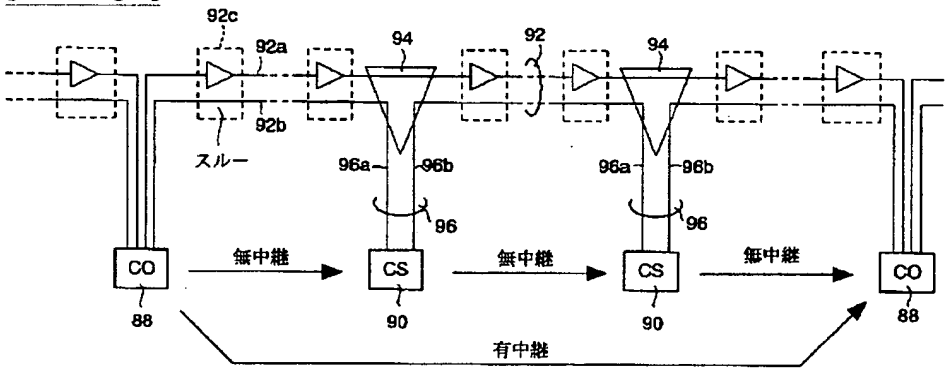

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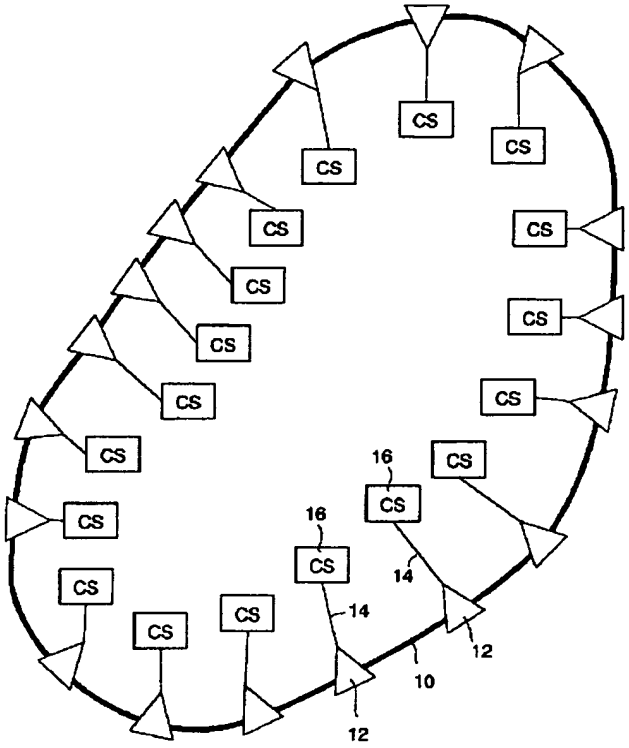

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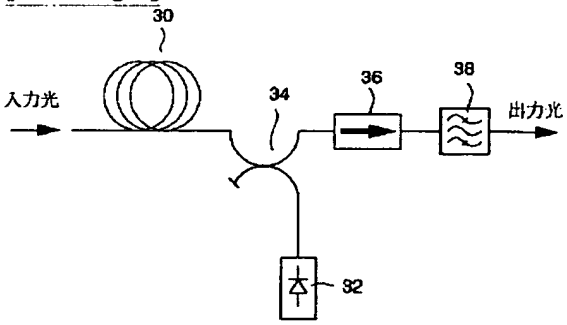
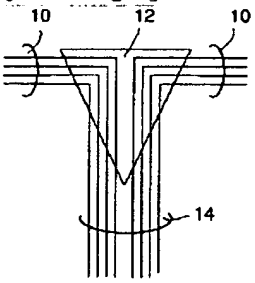


[Drawing 7]



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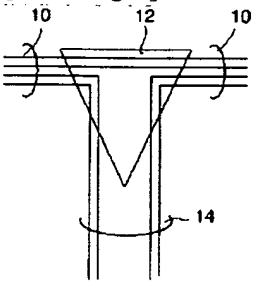

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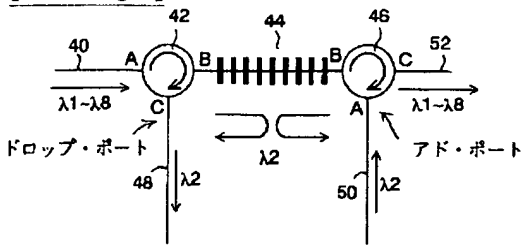
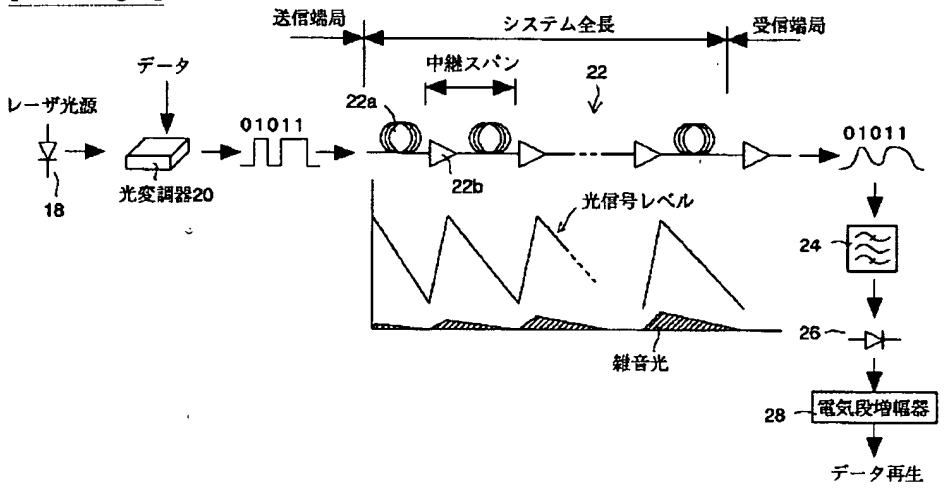
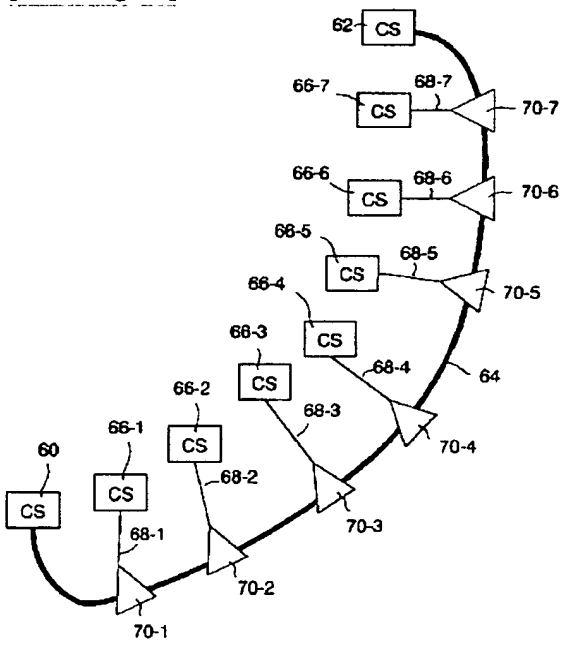


[Drawing 5]



[Drawing 10]



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